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EPA Scientific Advisory Board (SAB) Biogenic Carbon Emissions Panel
c/o Dr. Holly Stallworth
Designated Federal Officer (DFO)
SAB Staff Office
via email at stallworth.holly@epa.gov

Re: Comments on *1-19-12 DELIBERATIVE DRAFT report of the Biogenic Carbon Emissions Panel*

Dear EPA SAB Biogenic Carbon Emissions Panel:

Thank you for your considerable efforts to prepare the *Deliberative Draft report*. We agree with your general conclusions indicating the need for substantial revision of the September, 2011 *Framework*.

We would, however, like to point out a misinterpretation of climate science research with serious implications for the Panel's recommendations.

The *Deliberative Draft* (23/2-6, page/lines) states: Several different climate modeling studies have demonstrated that peak warming in response to greenhouse gas emissions is primarily sensitive to cumulative greenhouse gas emissions over a period of roughly 100 years, and is relatively insensitive to the emissions pathway within that time frame. Only Allen et al. (2009a) is referenced in support.

Allen et al. (2009a) indeed reported that peak warming was insensitive to the emissions pathway, but cumulative emissions in their simulated containment scenarios were constrained to one trillion tones of carbon (1 Tt C). This was intended to stabilize the climate by not exceeding global warming of 2 ºC. The ~100-year limit was an arbitrary constraint to coincide with the end of the 21st century, and the sensitivity of climate response to this variable was not tested by Allen et al. (2009a). As a related study showed, both cumulative emissions up to 2050 and emission levels in 2050 are robust indicators of the probability that twenty-first century warming will not exceed 2 ºC relative to pre-industrial temperatures (Meinshausen et al. 2009).

Although recent work has confirmed the finding of Allen et al. (2009a) that peak warming is insensitive to the timing of emissions when their quantity is constrained, peak responses of atmospheric CO_2 and surface ocean pH were found to be dependent on the emissions pathway (Zickfeld et al. 2011), with important implications for ecosystem function (CCSP 2009). Also, climate responses other than peak warming, such as the rate of temperature increase and the cumulative impact of raised temperatures, are of concern (Kirschbaum 2006), and these will be affected by the emissions pathway.

The *Deliberative Draft* overlooked the essential context provided by Allen et al. (2009b) that reveals the significance of emissions timing. The salient conclusions of this commentary were as follows: (i) keeping the most likely warming due to CO_2 alone to 2 °C to avoid dangerous climate change will require us to limit cumulative emissions over the period 1750–2500 to 1 Tt C, (ii) past greenhouse gas emissions have already committed us to warming of around 1 °C, (iii) having taken 250 years to burn the first half-trillion tonnes of carbon, we look set, on current trends, to burn the next half trillion in less than 40, and (iv) *the small size of the cumulative emission budgets to 2050 reinforces the need for global CO_2 emissions to peak around or before 2020 so that emission pathways remain technologically and economically feasible.*

Statement (iv), supported by subsequent research (Rogelj et al. 2011), clearly contradicts the *Deliberative Draft*'s incorrect inference (23/25-29): Scientific understanding of the timescale over which the climate system responds to cumulative emissions implies that the carbon release caused by harvesting and combusting biomass at stationary sources is a serious problem if the time for regrowth is much more than 100 years. This means that the climate system is not sensitive to the imbalance in the carbon cycle that might occur over decades from harvesting of biomass for bioenergy facilities.

As Allen et al. (2009b) noted, it is very difficult to fudge the implications of their analyses--the more CO_2 we dump into the atmosphere, the higher the committed warming. Each unit of CO_2 emissions results in a quantifiable step-wise increase of global temperatures (Mathews and Caldeira 2008). Furthermore, climate change due to *any* emissions is irreversible for 1,000 years after emissions stop (Solomon et al. 2009). Simulated atmospheric surface temperatures did not substantially decline for several centuries even after CO_2 emissions ceased completely (Cao and Caldeira 2010, and references therein).

Allen et al. (2009a) did not consider biogenic emissions with the possibility of vegetative reabsorption of emitted carbon. Numerous studies have demonstrated that the emissions pathway does matter in this case (e.g., Levasseur et al. 2010, Zanchi et al. 2010, Cherubini et al. 2011, 2012).

Properly treating emissions and decay over time increases the importance of near-term emissions because the cumulative warming and associated damages from those emissions, for any finite analytic horizon, are more severe (O'Hare et al. 2009). Compared to approaches that simply sum GHG emissions over time, O'Hare et al. (2009) showed that recognizing the physics of atmospheric CO_2 decay and radiative forcing significantly increased the estimated climate effects relative to fossil fuel for any biofuel causing land use change.

Of critical importance is the fact that carbon neutrality does not imply climate neutrality. This has been acknowledged since the early 1990s (Cherubini et al. 2011, and references therein). The time delay between biogenic CO_2 emissions and capture through vegetative regrowth results in a certain climate impact, even for a system that is carbon neutral over time (Cherubini et al. 2012). The climate impact of bioenergy systems cannot be estimated through a net balance of the CO_2 fluxes to and from the atmosphere. Instead it must be computed using their temporal profiles and integrating the biomass system within the global carbon cycle (Cherubini et al. 2012).

We agree with the recommendation of the Deliberative Draft (38/12-14) that the *Framework* should also make explicit the constraints within which greenhouse gases can be regulated under the Clean Air Act. The Supreme Court ruled in 2007 that the EPA had authority under the Clean Air Act to regulate certain greenhouse gas emissions if they endangered public welfare and the environment (http://laws.findlaw.com/us/000/05-1120.html).

Our comments above indicate that proper regulation will require an accounting framework that does not merely measure CO_2 fluxes, but also considers the climate impact of emissions.

We thank the EPA and the Panel for this opportunity to comment on their efforts to resolve the complex issues involved in carbon emissions accounting.

Sincerely,

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